IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

AF/2125

Applicant: Mark S. Boddy et al.

Title: AUTOMATED FINITE CAPACITY SCHEDULER

Docket No.: H16-17367 (256.029US1)
Filed: November 6, 1998
Examiner: Steven Garland
Customer No.: 000128

Serial No.: 09/188399
Due Date: November 10, 2003
Group Art Unit: 2125
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(GENERAL)

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Mark S. Boddy et al. Examiner: Steven Garland

Serial No.: 09/188399 Group Art Unit: 2125

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For: AUTOMATED FINITE CAPACITY SCHEDULER

APPELLANTS' BRIEF ON APPEAL

Mail Stop Appeal Brief
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Sir:

This Appeal Brief is presented in support of the Notice of Appeal to the Board of Patent Appeals and Interferences, filed on September 10, 2003, from the Final Rejection of claims **1-19, 27-29, 32-34** of the above-identified Application, as set forth in the Final Office Action mailed May 15, 2003. The Appellants respectfully request consideration and reversal of the Examiner's rejections of pending claims **1-19, 27-29, 32-34.**

This Appeal Brief is filed in triplicate and accompanied by the requisite fee set forth in 37 C.F.R. § 117(c). Please charge any required additional fees or credit overpayment to Deposit Account 19-0743.

APPELLANTS' BRIEF ON APPEAL

TABLE OF CONTENTS

1. REAL PARTY IN INTEREST

The real party in interest of the above-captioned patent application is the assignee, HONEYWELL INTERNATIONAL INC..

2. RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences known to Appellant that will have a bearing on the Board's decision in the present appeal.

3. STATUS OF THE CLAIMS

Claims 1-12, 13-19, 27-29, and 32-34 are pending in the application. Claim 12 is objected to, and the rest have been finally rejected. The rejected claims 1-11, 13-19, 27-29, and 32-34 are the subject of the present appeal.

4. STATUS OF AMENDMENTS

There are no amendments to the specification pending, and none have been presented after the Final Rejection of May 15, 2003 and Advisory Action of July 25, 2003.

5. SUMMARY OF THE INVENTION

A method of scheduling tasks creates a list of activities 410 required to accomplish the tasks. Selected activities are modified into sets of smaller activities at 410. The activities and smaller activities are scheduled based on both discrete and continuous constraints 432. The continuous constraints involve things like blend ratios, feed compositions and control set points, and are related to other variables by linear mathematical relationships. Page 5, lines 15-16. Discrete constraints involve things such as product sequencing, tank draws and storage, piping configurations which constrain where product may be routed. Page 5, lines 9-12. The activities may be modified as a function of integrated implications of the discrete and continuous constraints.

Given a list of products to be provided, the scheduler generates a set of activities 410 required to produce the products and identifies resources required 405 and the discrete and continuous constraints related to such resources 412. It then resizes the activities and creates a schedule based on such constraints 430. If an activity is very slow, or large, it may be broken down into smaller activities, or in some instances, larger activities based on predetermined parameters such as thresholds. (Page 11, lines 6-14) The activities may also be scheduled based on deadlines. (Page 10, line 9 to page 11, line 5.)

Both discrete and continuous constraints are defined as being of various types, including REQUIREMENT, DECISION, and PROPAGATION EFFECT. Page 7, lines 10-17. Separate engines 116 and 114 respectively are used to solve for the discrete and continuous constraint problems. Each engine modifies its respective constraints. Page 7, line 27 to page 8, line 19. Data structures (page 7, lines 5-26) are used to share and propagate constraints between the two engines such that they are integrated (page 6, lines 28-30, page 7, line 31 – page 8, line 13) to accomplish the tasks taking into account both types of constraints.

Infeasibilities of meeting product delivery times are detected 440 during the scheduling of each resource. Culprits causing an infeasibility are identified at 450. Several methods may be used to backtrack and reschedule resources 452 based on under and over utilization and availability of equivalent resources. One such method involves chronological back tracking with backjumping and dynamic variable ordering. (Page 12, lines 1-10).

In one embodiment, a method of scheduling activities involves defining discrete and continuous constraints related to activities. The continuous constraints are related to other variables by linear mathematical relationships. Selected scheduling decisions are represented as discrete and continuous constraints. Activities as scheduled in accordance with integrated implications of the discrete and continuous constraints.

6. ISSUES PRESENTED FOR REVIEW

1. Whether claims 1-3, 5-8, 10, 11, 13-19, 27-29, and 32-34 are patentable under 35 USC § 103(a) over Goldman et al. (A Constraint-Based-Scheduler for Batch Manufacturing) in view of Tanaka (U.S. Patent No. 5,353,229).

2. Whether claims 1-11, 14, 15, 19, 27-29, 33, and 34 are patentable under 35 USC § 103(a) over Zweben et al. (U.S. Patent No. 6,216,109) in view of Tanaka (U.S. Patent No. 5,353,229).

7. GROUPING OF CLAIMS

Claims 1-11, 13, 27 and 33 are grouped together. Claims 14-17, 28, 32 and 34 are grouped together. Claims 19 and 29 are grouped together. Claim 18 stands alone and is argued separately for purposes of this appeal.

8. ARGUMENT

Rejections Under 35 U.S.C. § 103

1) The Applicable Law

The Examiner has the burden under 35 U.S.C. § 103 to establish a *prima facie* case of obviousness. *In re Fine*, 837 F.2d 1071, 1074, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). To do that the Examiner must show that some objective teaching in the prior art or some knowledge generally available to one of ordinary skill in the art would lead an individual to combine the relevant teaching of the references. *Id.*

The court in *Fine* stated that:

> Obviousness is tested by "what the combined teaching of the references would have suggested to those of ordinary skill in the art." *In re Keller*, 642 F.2d 413, 425, 208 USPQ 871, 878 (CCPA 1981)). But it "cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching or suggestion supporting the combination." *ACS Hosp. Sys.*, 732 F.2d at 1577, 221 USPQ at 933. And "teachings of references can be combined *only* if there is some suggestion or incentive to do so."

Id. (emphasis in original).

The M.P.E.P. adopts this line of reasoning, stating that

> In order for the Examiner to establish a *prima facie* case of obviousness, three base criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference

> teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on Appellant's disclosure.

M.P.E.P. § 2142 (citing *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)).

An invention can be obvious even though the suggestion to combine prior art teachings is not found in a specific reference. *In re Oetiker*, 24 USPQ2d 1443 (Fed. Cir. 1992). At the same time, however, although it is not necessary that the cited references or prior art specifically suggest making the combination, there must be some teaching somewhere which provides the suggestion or motivation to combine prior art teachings and applies that combination to solve the same or similar problem which the claimed invention addresses. One of ordinary skill in the art will be presumed to know of any such teaching. (See, e.g., *In re Nilssen*, 851 F.2d 1401, 1403, 7 USPQ2d 1500, 1502 (Fed. Cir. 1988) and *In re Wood*, 599 F.2d 1032, 1037, 202 USPQ 171, 174 (CCPA 1979)).

The Office Action must provide specific, objective evidence of record for a finding of a suggestion or motivation to combine reference teachings and must explain the reasoning by which the evidence is deemed to support such a finding. *In re Sang Su Lee*, 277 F.3d 1338, 61 U.S.P.Q.2d 1430 (Fed. Cir. 2002). Mere conclusory statements are unsatisfactory.

> "With respect to Lee's application, neither the examiner nor the Board adequately supported the selection and combination of the Nortrup and Thunderchopper references to render obvious that which Lee described. The examiner's conclusory statements that 'the demonstration mode is just a programmable feature which can be used in many different devices for providing automatic introduction by adding the proper programming software" and that "another motivation would be that the automatic demonstration mode is user friendly and it functions as tutorial" do not adequately address the issue of motivation to combine. This factual question of motivation is material to patentablility, and could not be resolved on subjective belief and unknown authority. It is improper, in determining whether a person of ordinary skill in the art would have been lead to this combination of references, simply to use '[use] that which the inventor taught against its teacher.' *W.L. Gore V. Garlock, Inc.*, 721 F. 2d 1540, 1553, 220 USPQ 303, 312-13 (Fed. Cir. 1983)." *Lee,* at 1343, 1344.

The test for obviousness under § 103 must take into consideration the invention as a whole; that is, one must consider the particular problem solved by the combination of elements that define the invention. *Interconnect Planning Corp. v. Feil*, 774 F.2d 1132, 1143, 227 USPQ 543, 551 (Fed. Cir. 1985). Furthermore, claims must be interpreted in light of the specification, claim language, other claims and prosecution history. *Panduit Corp. v. Dennison Mfg. Co.*, 810 F.2d 1561, 1568, 1 USPQ2d 1593, 1597 (Fed. Cir. 1987), *cert. denied*, 481 U.S. 1052 (1987). At the same time, a prior patent cited as a § 103 reference must be considered in its entirety, "*i.e.* as a *whole*, including portions that lead away from the invention." *Id.* That is, the Examiner must, as one of the inquiries pertinent to any obviousness inquiry under 35 U.S.C. § 103, recognize and consider not only the similarities but also the critical differences between the claimed invention and the prior art. *In re Bond*, 910 F.2d 831, 834, 15 USPQ2d 1566, 1568 (Fed. Cir. 1990), *reh'g denied*, 1990 U.S. App. LEXIS 19971 (Fed. Cir. 1990). Finally, the Examiner must avoid hindsight. *Id.*

Claims 1-3, 5-8, 10, 11, 13-19, 27-29, and 32-34 were rejected under 35 USC § 103(a) as being unpatentable over Goldman et al. (A Constraint-Based-Scheduler for Batch Manufacturing) in view of Tanaka (U.S. Patent No. 5,353,229). This rejection should be overturned for several reasons.

Goldman et al. does not teach resizing or modifying activities into smaller activities, and therefore further does not discuss scheduling both activities and smaller activities based on different types of constraints as claimed.

In response to applicant's previous arguments, Examiner cites the example of batch manufacturing in the boxes on the tops of pages 52 and 53 as showing "various levels of granularity subject to various constraints (note in addition to the breakdown of the general recipe into a site recipe and unit recipes)" Applicant respectfully traverses the assertion that a site and unit recipe are similar in any conceivable manner to modifying selected activities into sets of smaller activities and scheduling them based on discrete and continuous constraints. A site recipe "describes how a product is made at a particular plant" Page 53 box. "Each unit recipe describes the set of operations a particular piece of plant equipment will execute" Page 53 box.

There is no discussion of modifying activities into smaller activities and scheduling them based on discrete and continuous constraints as claimed.

Tanaka does not describe the use of continuous constraints. The constraints C1, C2 and C3 in Tanaka are all discrete constraints. Therefore, it does not represent continuous constraints by linear mathematical relationships with variables. Tanaka also fails to consider resizing activities into smaller activities or scheduling both activities and smaller activities based on continuous and linear constraints. Thus, the combination of references fails to teach the invention as claimed.

Even if the references teach the elements indicated by the Examiner, there is no suggestion to combine them. The office action indicates that "It would have been obvious to one of ordinary skill in the art to modify Goldman in view of Tanaka and express the continuous constraints by a linear mathematical formula so that the constraints can be accurately related to the variables and also allow ease in computation." This argument is flawed in many respect. It is a subjective conclusion that is not based on objective evidence. It is also flawed in that Tanaka does not teach such a representation of continuous constraints. Still further, Goldman does not address the division of an activity into a set of smaller activities.

Because the references cited here fail to teach all elements of the pending claims, including both modifying selected activities into sets of smaller activities and scheduling the activities and smaller activities based on discrete and continuous constraints that are related to other variables by linear mathematically relationships, the pending claims are believed to be patentably distinct from these cited references.

Each of claims 1-11, 13, 27 and 33 contain the recitation that the activities and smaller activities are scheduled "based on discrete and continuous constraints, wherein the continuous constraints are related to other variables by linear mathematical relationships." As such, their rejection should be overturned.

Claims 14-17, 28, 32 and 34 each recite the use of discrete and continuous constraints, and that the continuous constraints are related to other variables by linear mathematical relationships. These elements are not taught or suggested by the references alone or combined. Further, they recite that activities are scheduled "in accordance with integrated implications of

the discrete and continuous constraints." This language is not discussed in the rejections, and so the rejection of these claims should be overturned.

Claims 19 and 29 recite modifying activities into sets of smaller activities, modifying both discrete and continuous constraints, and that the continuous constraints are related to other variables by linear mathematically relationships. As indicated with respect to claim 1, modifying the activities into sets of smaller activities is not shown in Goldman. Further, the Examiner does not point out where the references discuss modifying the discrete and continuous constraints. Further, the relationship of the continuous constraints to other variable in the manner claimed is not shown in the references. The rejection of these claims should be overturned.

Claim 18 is similar to claim 12, which was indicated as allowable, in that it references "chronological backtracking" Further, the Examiner has not shown where this function is shown in the references. As such, the rejection should be overturned.

Claims 1-11, 14, 15, 19, 27-29, 33, and 34 were rejected under 35 USC § 103(a) as being unpatentable over Zweben et al. (U.S. Patent No. 6,216,109) in view of Tanaka (U.S. Patent No. 5,353,229).

Zweben teaches constraint-based iterative repair of a schedule for a complex activity, such that repairs are made in each iteration of a schedule until a schedule not producing a constraint violation is obtained as a result. The system is specifically designed to only repair violated constraints and not to modify the entire preexisting schedule, minimizing perturbations of the existing schedule. The Examiner references Col. 16, lines 52-54: "A preemptive constraint can cause a task to be split into subtasks. (For instance, in the example above, the 16 hour task is split into two 8 hour subtasks.)" This is done because a work shift can only work 8 hours at a time. Zweben does not schedule activities and smaller activities that were obtained from the activities "based on discrete and continuous constraints, wherein the continuous constraints are related to other variables by linear mathematical relationships" as claimed in claim 1.

In contrast, the pending claims recite modifying selected activities into sets of smaller activities, and scheduling both activities and smaller activities based on discrete and continuous constraints. More specifically, the invention as claimed in the pending claims involves selecting

activities for division into smaller activities, modifying these selected activities into smaller activities, and scheduling both these modified or divided smaller activities along with other activities from the list of activities based on both discrete and continuous constraints.

The Office Action specifically references Col. 16, lines 4-61 in regard to the "splitting aspect". This language has been carefully reviewed, and it does not teach or suggest the splitting aspect. This language references the state of an attribute "absent change by another task... For example, a task can have an effect that changes a switch from on to off. The state effect can specify that the switch remains off until the end of the task, or the state effect can specify that the switch remains off until some other task turns the switch back on." Col. 16, lines 7-14. The referenced language further describes constraints on when a task can be performed starting at line 39. No teaching or suggestion of modifying selected activities into smaller activities has been found in the referenced language. Because the cited Zweben reference does not discuss modifying sets of activities into smaller activities and scheduling the activities and smaller activities based on discrete and continuous constraints, the claims of the present invention are believed to be patentably distinct from the cited reference. Reconsideration and allowance of the claims is respectfully requested.

The references are not properly combinable for the same reasons as provided with respect to the combination of Goldman with Tanaka. The same rationale was provided by the Examiner for the combination of Zweben and Tanaka, and again, it is a subjective statement of belief. It is also flawed in that Tanaka does not teach such a representation of continuous constraints. Still further, Zweben does not address the division of an activity into a set of smaller activities.

Each of claims 1-11, 27 and 33 contain the recitation that the activities and smaller activities are scheduled "based on discrete and continuous constraints, wherein the continuous constraints are related to other variables by linear mathematical relationships." As such, their rejection should be overturned.

Claims 14-15, 28, and 34 each recite the use of discrete and continuous constraints, and that the continuous constraints are related to other variables by linear mathematical relationships. These elements are not taught or suggested by the references alone or combined. Further, they recite that activities are scheduled "in accordance with integrated implications of the discrete and

continuous constraints." This language is not discussed in the rejections, and so the rejection of these claims should be overturned.

Claims 19 and 29 recite modifying activities into sets of smaller activities, modifying both discrete and continuous constraints, and that the continuous constraints are related to other variables by linear mathematically relationships. As indicated with respect to claim 1, modifying the activities into sets of smaller activities is not shown in Goldman. Further, the Examiner does not point out where the references discuss modifying the discrete and continuous constraints. Further, the relationship of the continuous constraints to other variable in the manner claimed is not shown in the references. The rejection of these claims should be overturned.

9. SUMMARY

Applicant believes the claims are in condition for allowance and requests withdrawal of the rejections to claims 1-11, 13-19, 27-29, and 32-34. Reversal of the Examiner's rejections of claims 1-11, 13-19, 27-29, and 32-34 in this appeal is respectfully requested.

Respectfully submitted,

MARK S. BODDY et al.

By their Representatives,

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Gina M. Uphus
Name

_____
Signature

APPENDIX I

The Claims on Appeal

1. (Previously Amended) A method of scheduling tasks comprising:

creating a list of activities required to accomplish the tasks;

modifying selected activities into sets of smaller activities; and

scheduling the activities and smaller activities based on discrete and continuous constraints, wherein the continuous constraints are related to other variables by linear mathematical relationships.

2. (Original) The method of claim 1 wherein modifying selected activities is performed as a function of integrated implications of the discrete and continuous constraints.

3. (Original) The method of claim 1 wherein modifying selected activities comprises determining if an activity is larger than a predetermined threshold.

4. (Original) The method of claim 1 wherein modifying selected activities comprises determining if an activity occurs slower than a predetermined threshold.

5. (Original) The method of claim 1 and further comprising defining discrete and continuous constraints related to the activities based on requirements of the tasks.

6. (Original) The method of claim 5 wherein activities are assigned start and end times.

7. (Original) The method of claim 5 wherein activities are scheduled based on deadlines.

8. (Original) The method of claim 5 wherein the requirements of the task comprise identification of resources required to perform the task.

9. (Original) The method of claim 8 wherein activities are assigned resources based on a resource balancing heuristic.

10. (Original) The method of claim 1 and further comprising identifying infeasibilities during the scheduling of activities.

11. (Original) The method of claim 10 and further comprising identifying a culprit activity when an infeasibility is identified.

12. (Original) The method of claim 11 and further comprising chronological backtracking to the culprit activity which resulted in an infeasibility.

13. (Original) The method of claim 1 and further comprising identifying suboptimalities during the scheduling of activities and identifying culprit activities causing the suboptimalities.

14. (Previously Amended) A method of scheduling activities comprising:

defining discrete and continuous constraints related to the activities, wherein the continuous constraints are related to other variables by linear mathematical relationships;

representing selected scheduling decisions as discrete and continuous constraints; and

scheduling activities in accordance with integrated implications of the discrete and continuous constraints.

15. (Previously Amended) The method of claim 14 and further comprising:

scheduling activities in accordance with previous scheduling decision constraints;

identifying infeasibilities during the scheduling of activities; and

scheduling activities in accordance with identified infeasibilities.

16. (Previously Amended) The method of claim 15 and further comprising:

identifying a culprit activity which resulted in an infeasibility; and

backtracking to the culprit and rescheduling the culprit activity.

17. (Original) The method of claim 16 and further comprising identifying a culprit activity which resulted in a suboptimality.

18. (Original) The method of claim 16 wherein the backtracking comprises chronological backtracking or dynamic backtracking.

19. (Previously Amended) A method of modifying scheduled tasks comprising:

updating information related to the scheduled tasks;

modifying a list of activities required to accomplish the tasks based on the updated information;

optionally modifying the activities into sets of smaller activities;

modifying discrete constraints related to the activities;

modifying continuous constraints related to the activities, wherein the continuous constraints are related to other variables by linear mathematical relationships; and

scheduling the activities and smaller activities based on discrete and continuous constraints.

20-26 (Canceled)

27. (Previously Amended) A machine readable medium having computer executable instructions stored thereon for causing a computer to perform a method of scheduling tasks comprising:

creating a list of activities required to accomplish the tasks;

modifying selected activities into sets of smaller activities; and

scheduling the activities and smaller activities based on discrete and continuous

constraints, wherein the continuous constraints are related to other variables by linear mathematical relationships.

28. (Previously Amended) A machine readable medium having computer executable instructions stored thereon for causing a computer to perform a method of scheduling activities comprising:

defining discrete and continuous constraints related to the activities, wherein the continuous constraints are related to other variables by linear mathematical relationships;

representing selected scheduling decisions as discrete and continuous constraints; and

scheduling activities in accordance with an integrated implications of the discrete and continuous constraints.

29. (Previously Amended) A machine readable medium having computer executable instructions stored thereon for causing a computer to perform a method of modifying scheduled tasks comprising:

updating information related to the scheduled tasks;

modifying a list of activities required to accomplish the tasks based on the updated information;

optionally modifying the activities into sets of smaller activities;

modifying discrete constraints related to the activities;

modifying continuous constraints related to the activities, wherein the continuous constraints are related to other variables by linear mathematical relationships; and

scheduling the activities and smaller activities based on discrete and continuous constraints.

30-31 (Canceled)

32. (Previously Amended) A system for scheduling tasks comprising:

a continuous constraint solver engine;

a discrete constraint solver engine; and

means for integrating the engines to schedule activities to accomplish the tasks taking into account both continuous constraints and discrete constraints, wherein the continuous constraints are related to other variables by linear mathematical relationships.

33. (Previously Amended) A system for scheduling tasks comprising:

means for creating a list of activities required to accomplish the tasks;

means for modifying the activities into sets of smaller activities; and

means for scheduling the activities and smaller activities based on discrete and continuous constraints, wherein the continuous constraints are related to other variables by linear mathematical relationships.

34. (Previously Amended) A system for scheduling tasks comprising:

a constraint module that defines discrete and continuous constraints related to the activities, wherein the continuous constraints are related to other variables by linear mathematical relationships;

a module that represents scheduling decisions as discrete and continuous constraints; and

a scheduling module that schedules activities in accordance with an integrated implications of the discrete and continuous constraints.